This application is a divisional of application Serial No. 09/928,126, filed on August 10, 2001, which claims priority from provisional application Serial No. 60/225,666, filed August 16, 2000, now expired, the entire disclosures of which are incorporated by reference herein.

In the Claims:

Please cancel claims 1–53.

Please amend claims 54 and 55 as follows.

54. (Amended) A semiconductor structure comprising:

a substrate including an insulator layer;

a first layer of relaxed $Si_{1-x}Ge_x$ disposed over the insulator layer, wherein x has a value in the range of 0.1 to 1; and

a second layer disposed over the substrate, the second layer comprising a material selected from the group consisting of GaAs, AlAs, ZnSe, InGaP, and strained $Si_{1-y}Ge_y$ wherein y has a value different from the value of x.

55. (Amended) A semiconductor structure comprising:

a substrate; and

a plurality of layers disposed over the substrate, the layers comprising:

a graded $Si_{1-x}Ge_x$ buffer layer, the graded buffer layer having a Ge concentration x, wherein x has a value that increases from zero to a value y;

a first relaxed layer comprising $Si_{1-y}Ge_y$; and

a separation layer comprising at least one material selected from the group consisting of strained $Si_{1-z}Ge_z$ with $z \neq y$, III-V materials, and II-VI materials.

Please add new claims 56-110:

56. (New) The structure of claim 54 wherein the value of x is in the range of 0.3 to 1.

57. (New) A semiconductor structure comprising:

a substrate;

a first layer of relaxed $Si_{1-x}Ge_x$ disposed over the substrate, x having a value in the range of 0.1 to 1;

a second layer disposed over the substrate, the second layer comprising at least one material selected from the group consisting of GaAs, AlAs, ZnSe, InGaP, and strained $Si_{1-y}Ge_y$ wherein y has a value different from the value of x; and

a plurality of ions disposed in at least one of the first layer and the second layer.

58. (New) The structure of claim 57 wherein the ions comprise at least one of hydrogen H^+ ions and H_2^+ ions.

59. (New) The structure of claim 55 wherein a surface of the structure has a root mean square surface roughness of less than about 11 angstroms.

60. (New) The structure of claim 55, further comprising:

a second relaxed layer.

61. (New) The structure of claim 60 wherein the second relaxed layer comprises relaxed $Si_{1-w}Ge_w$ and w is substantially equal to y.

62. (New) The structure of claim 60 wherein y is approximately equal to 1 and the second relaxed layer comprises at least one material selected from the group consisting of Ge, GaAs, AlAs, ZnSe, and InGaP.

63. (New) The structure of claim 55, further comprising:

a plurality of ions disposed in the structure.

64. (New) The structure of claim 63 wherein the ions comprise at least on of hydrogen H^+ ions and H_2^+ ions.

65. (New) The structure of claim 63 wherein the ions are disposed in the separation layer.

66. (New) The structure of claim 63 wherein the separation layer comprises a strained layer and the ions are disposed in one of the graded buffer layer and the first relaxed layer.

67. (New) The structure of claim 55, further comprising:

an oxide layer disposed over the plurality of layers.

68. (New) The structure of claim 55, further comprising:

a device integrated into at least a portion of the plurality of layers.

69. (New) The semiconductor structure of claim 55 wherein the separation layer comprises a strained layer.

70. (New) The semiconductor structure of claim 55 wherein the separation layer comprises a defect layer.

71. (New) A semiconductor structure comprising:

a substrate comprising silicon;

an insulating layer disposed over the substrate; and

a relaxed $Si_{1-x}Ge_x$ layer disposed over the insulating layer, the relaxed $Si_{1-x}Ge_x$ layer having a uniform composition and a dislocation defect density of less than $10^6/cm^2$.

72. (New) The structure of claim 71 wherein a Ge concentration x of the relaxed layer is in the range of zero to 1.

73. (New) The structure of claim 72 wherein the Ge concentration x is in the range of 0.3 to 1.

74. (New) The structure of claim 71, further comprising:

a device layer disposed over the relaxed $Si_{1-x}Ge_x$ layer.

75. (New) The structure of claim 71 wherein the device layer comprises at least one material selected from the group consisting of strained Si, strained $Si_{1-y}Ge_y$ with $y \neq x$, III-V materials, and II-VI materials.

76. (New) The structure of claim 71, further comprising:

a device disposed within at least a portion of the relaxed $Si_{1-x}Ge_x$ layer.

77. (New) A semiconductor structure comprising:

a relaxed $Si_{1-y}Ge_y$ layer disposed on a substrate; and

a buried layer defined by implanted ions disposed in the relaxed $Si_{1-y}Ge_y$ layer.

78. (New) A semiconductor structure comprising:

a first heterostructure including:

a graded $Si_{1-x}Ge_x$ buffer layer disposed on a first substrate, the graded $Si_{1-x}Ge_x$ buffer layer having a Ge concentration x increasing from zero to a value y;

a relaxed $Si_{1-y}Ge_y$ layer disposed on the graded $Si_{1-x}Ge_x$ buffer layer; and

a buried layer defined by implanted ions disposed in one of said graded $Si_{1-x}Ge_x$ buffer layer and relaxed $Si_{1-y}Ge_y$ layer.

79. (New) The semiconductor structure of claim 78 wherein the implanted ions comprise at least one of H^+ ions and H_2^+ ions.

80. (New) The semiconductor structure of claim 78 wherein a surface of the structure has a roughness less than about 11 nanometers.

81. (New) The semiconductor structure of claim 78, further comprising:

an oxide layer disposed over the first heterostructure.

82. (New) The semiconductor structure of claim 78 wherein the first heterostructure is bonded to a second substrate, defining a second heterostructure.

83. (New) The semiconductor structure of claim 82 wherein the second substrate comprises an insulator layer and the first heterostructure is bonded to the insulator layer.

84. (New) The semiconductor structure of claim 83 wherein the insulator layer comprises an oxide layer.

85. (New) A semiconductor structure comprising:

a substrate; and

a semiconductor layer bonded to the substrate, the semiconductor layer having a surface roughness of less than about 11.3 nanometers.

86. (New) The semiconductor structure of claim 85 wherein the semiconductor layer comprises at least one of relaxed $Si_{1-y}Ge_y$,GaAs, AlAs, ZnSe, and InGaP.

87. (New) The semiconductor structure of claim 86 wherein the semiconductor layer comprises a surface damage layer.

88. (New) The semiconductor structure of claim 86 wherein the surface damage layer has a thickness of less than about 100 nanometers.

89. (New) The semiconductor structure of claim 85, further comprising:

a device disposed within at least a portion of the semiconductor layer.

90. (New) A semiconductor structure comprising:

a first heterostructure including:

a graded $Si_{1-x}Ge_x$ buffer layer disposed on a first substrate, the graded $Si_{1-x}Ge_x$ buffer layer having a Ge concentration x increasing from zero to 1;

a relaxed Ge layer disposed on the graded $Si_{1-x}Ge_x$ buffer layer;

a semiconductor layer disposed on the relaxed Ge layer; and

a buried layer disposed within at least one of the graded $Si_{1-x}Ge_x$ buffer layer, the semiconductor layer, and the relaxed Ge layer, the buried layer being defined by ions.

91. (New) The semiconductor structure of claim 90 wherein the implanted ions comprise at least one of H^+ ions and H_2^+ ions.

92. (New) The structure of claim 90 wherein the first heterostructure is bonded to a second substrate, thereby defining a second heterostructure.

93. (New) The semiconductor structure of claim 92, further comprising:

a device disposed within at least a portion of the semiconductor layer.

94. (New) A semiconductor structure comprising:

a first heterostructure including:

a graded $Si_{1-x}Ge_x$ buffer layer disposed on a first substrate, the graded $Si_{1-x}Ge_x$ buffer layer having a Ge concentration x increasing from zero to a value y;

a relaxed $Si_{1-z}Ge_z$ layer disposed on the graded $Si_{1-x}Ge_x$ buffer layer, z being greater than y; and

a buried layer defined by ions disposed within the graded $Si_{1-x}Ge_x$ buffer layer.

95. (New) The semiconductor structure of claim 94 wherein the implanted ions comprise at least one of H^+ ions and H_2^+ ions.

96. (New) The semiconductor structure of claim 94 wherein the first heterostructure is bonded to a second substrate, defining a second heterostructure.

97. (New) The semiconductor structure of claim 94, further comprising:

a device disposed within at least a portion of the semiconductor layer.

98. (New) A semiconductor structure comprising:

a substrate; and

a relaxed $Si_{1-z}Ge_z$ layer bonded to the substrate,

wherein a surface of the $Si_{1-z}Ge_z$ layer is defined by a selective etch.

99. (New) A semiconductor structure comprising:

a first heterostructure including:

a graded $Si_{1-x}Ge_x$ buffer layer disposed on a first substrate, wherein the graded $Si_{1-x}Ge_x$ buffer layer has a Ge concentration x increasing from zero to a value y;

a relaxed $Si_{1-y}Ge_y$ layer disposed on the graded $Si_{1-x}Ge_x$ buffer layer;

a separation layer disposed on the relaxed $Si_{1-y}Ge_y$ layer;

a second relaxed layer disposed over the separation layer; and

a plurality of ions disposed in at least one of the graded buffer layer, the relaxed layer, the separation layer, and the second relaxed layer.

100. (New) The semiconductor structure of claim 99 wherein the implanted ions comprise at least one of H^+ ions and H_2^+ ions.

101. (New) The semiconductor structure of claim 99 wherein the first heterostructure is bonded to a second substrate, defining a second heterostructure.

102. (New) The semiconductor structure of claim 101, further comprising:

a device disposed within at least a portion of the second heterostructure.

103. (New) A semiconductor structure comprising:

a relaxed layer bonded to a substrate; and

a strained layer disposed on the relaxed layer.

104. (New) The structure of claim 103 wherein the relaxed layer comprises a material selected from the group consisting of relaxed $Si_{1-w}Ge_w$, Ge, GaAs, AlAs, ZnSe, and InGaP.

105. (New) The structure of claim 103 wherein the strained layer comprises a material selected from the group consisting of strained $Si_{1-z}Ge_z$ and III-V material.

106. (New) The semiconductor structure of claim 103, further comprising:

a device disposed within at least a portion of the strained layer.

107. (New) A semiconductor structure comprising:

a first heterostructure including:

a layer structure comprising:

a graded $Si_{1-x}Ge_x$ buffer layer disposed on a first substrate, wherein the Ge concentration x increases from zero to a value y, and

a relaxed $Si_{1-z}Ge_z$ layer disposed over the graded $Si_{1-x}Ge_x$ buffer layer, wherein z is substantially equal to or greater than y; and

a buried layer disposed in the layer structure.

108. (New) The structure of claim 107 wherein the buried layer comprises implanted ions.

109. (New) The structure of claim 107 wherein the implanted ions comprise at least one of hydrogen H^+ ions and H_2^+ ions.

110. (New) The structure of claim 107, wherein the first heterostructure is bonded to a second substrate to define a second heterostructure.